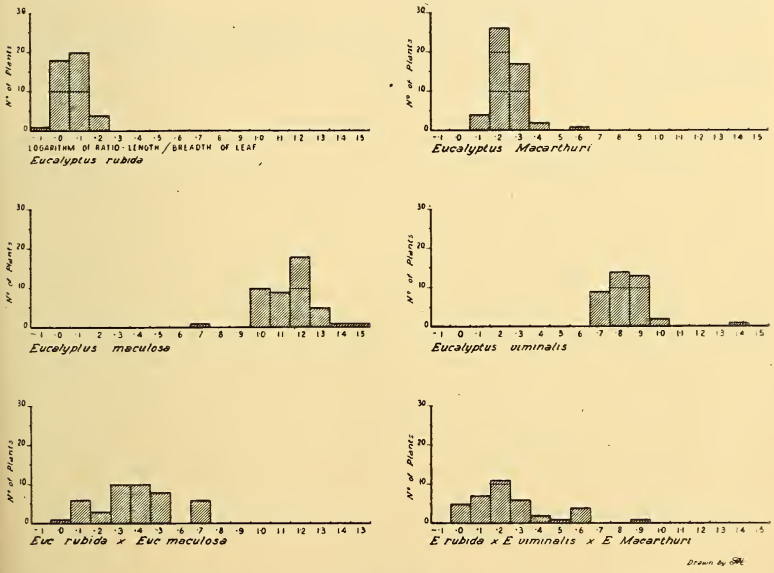
The progeny from the resistant tree shows marked segregation in the juvenile foliage characters. Some of the plants are like *E. maculosa* and others like *E. rubida*, with a series of grading intermediates between them.

The juvenile foliage of *E. maculosa* is quite different from that of *E. rubida*. *E. maculosa* has narrow-lanceolate or almost linear juvenile leaves, with short petioles which are alternately placed after the first few pairs. They are not glaucous although sometimes greyish-green in colour. On the other hand, *E. rubida* has orbicular, highly glaucous juveniles which are sessile and strictly opposite one another for many pairs. The leaves are also generally somewhat emarginate.



Text-figure 1.

Histograms of numbers of individuals of different classes for the ratio, leaf length to leaf breadth. The arithmetical data were transformed to logarithms to reduce the variance in the progenies from the supposedly pure parents to the same order.

The seedlings in the progeny display a range of combinations which are at the extremes almost identical with the two species, but which grade from one to the other through a series of intermediate forms which show various combinations and blends of the various parental characters (Pl. xv. fig. 2). There is a preponderance of forms which approach that which is intermediate between the putative parents. Glaucousness seems to assort quite independently of the other characters with which it is normally associated in *E. rubida*.

The ratio length/breadth of leaf is a convenient measure of the difference in leaf shape. Simple histograms (Text-fig. 1) have been prepared based on the number of individuals with different ratios, which give expression simply to the kind of variation which occurs in the various progenies. It was found in preparing these data that the variance in progenies from the presumed parental species could be reduced to the same order by transforming the figures to logarithms in the manner suggested by Mather (1949). Two points are clear from the histograms. Firstly, the distinct separation of the parental types and the relatively small variation of each, and the wide variation in the hybrid progenies together with their intermediate characters.

The same kind of variation exists with at least some other characters, but measurement is less simple and has not been made.

It seems clear from the morphology of the mature trees and the kind of variation present in the progeny that the resistant individual is of hybrid origin with *E. rubida* and *E. maculosa* as parents. The kind of variation in the progeny suggests that the resistant individual is a segregate in an F3 or later generation which approaches more closely to *E. rubida* than to *E. maculosa*, since the mean of the ratio of leaf measurements L/B falls nearer to that of *E. rubida* than *E. maculosa*. This impression is supported by evidence obtained elsewhere by Barber (1952) on a known F1 hybrid, and other information which will be published later.

The character which confers resistance to *Anaplognathus* is apparently inherited from *E. maculosa*, as this species is highly resistant to *Anaplognathus* attack and survives almost untouched in areas in which alternating trees of *E. rubida* and *E. maculosa* occur and in which *E. rubida* is heavily defoliated.

Individual Susceptibility.

A plantation of some twenty trees of *E. Macarthuri* about 25 years old contained one tree which was susceptible to scarab attack. *E. Macarthuri* is at times fairly heavily eaten but in the summer of 1950–51 was only lightly eaten in the area in question. The test tree on the other hand, while not completely defoliated like the *E. rubida*, was nevertheless very heavily eaten.

It is somewhat distinct from the *E. Macarthuri* amongst which it is planted and may be distinguished from them at sight by the more open crown, lighter coloured leaves and relatively small amount of fibrous bark on the trunk. In the case of *E. Macarthuri* the rough bark extends over the main trunk to limbs of about six-inch diameter, while in the case of the tree in question the rough bark extends for a few feet only at the butt. At the same time the tree seems to have some of the characters of *E. Macarthuri*, and while it cannot be assigned to this species it cannot readily be placed with any other. In the hand specimen it shows characters which, like the previous case, indicate probable hybrid origin.

E. Macarthuri commonly has umbels with 6–8 flowers. The tree in question has many such umbels but it also has occasionally three-flowered umbels. The fruit is also small and nearer the size of *E. Macarthuri* than other species (Pl. xv, fig. 1).

As with the previous case a progeny test was carried out.

Progeny Test.

Fifty plants were again raised in the same way from open-pollinated fruits. They display very variable juvenile characters suggesting marked segregation in a rather complex hybrid combination. The parent is not so clearly intermediate between *E. Macarthuri* and another parent as in the former case; the *E. Macarthuri* characters are less prominent than might be expected in a simple blend between two species as in an F1 hybrid. While this might be explained as due to dominance of some characters inherited from one parent, this would be quite unusual in *Eucalyptus* where seedling morphological characters generally show blending in hybrid combinations.

The progeny however discloses additional features of interest. There appear to be three parental types concerned in the combination, viz., *E. rubida*, *E. viminalis* and *E. Macarthuri*. The juvenile characters of *E. viminalis* are not widely different from those of *E. Macarthuri*. *E. viminalis* has opposite, sessile, narrow-lanceolate green leaves, while *E. Macarthuri* usually has a broad base giving a broad-lanceolate or ovate shape. Otherwise it is like *E. viminalis*. *E. Macarthuri* is characterized at all stages however by the highly distinctive oil which contains geranyl acetate and which, when present in sufficiently high concentration, can be detected readily by smell.

In the progeny from this susceptible individual there appears to be *E. viminalis*, there is clearly *E. rubida*, while *E. Macarthuri* is clearly represented in leaf shape but only faintly by the oil character (Pl. xv, fig. 3).

The presence of *E. viminalis* is interesting, as this species, or trees very much like it, appears quite often in progenies of *E. Macarthuri*. *E. Macarthuri* is one of those

species of limited geographic distribution which exhibit greater variation in their genetic makeup than some of the more widespread species. It is suggested that they are of comparatively recent origin—that they are polymorphs in which genetic variability has not yet been reduced to the level characteristic of more stable species. If this supposition is correct, *E. Macarthuri* might well be a polymorph derived partly from *E. viminalis* and the presence of the *E. viminalis* in the progeny might arise inherently from *E. Macarthuri*. As the progeny becomes older and other characters are available for assessing the biotypes present, this will become clearer.

In any case there is no doubt that the individual concerned is a somewhat complex hybrid and its susceptibility compared with *E. Macarthuri*, which is almost as resistant to *Anaplognathus* as *E. maculosa*, is probably a result of inheritance from *E. rubida*. The histogram (Text-fig 1) similar to that prepared for the first progeny illustrates the diversity and intermediate position in leaf shape of the hybrid progeny as compared with *E. Macarthuri*, *E. viminalis* and *E. rubida*.

While the genetic analysis is incomplete, since it is based on open-pollinated progeny tests and on juvenile characters of the plants, the evidence is so strong that there is little doubt that the individuals examined are of hybrid origin and that their susceptibility or resistance is a consequence of inherent qualities passed to them by one or other of their parents. The reliability of the progeny test in assessing the genetic makeup is perhaps greater than might at first appear. In the case of *E. rubida* × *E. maculosa* hybrid, the only *Eucalyptus* species within 800 yards of this tree is *E. rubida*. The nearest *E. maculosa* is further away. Self-fertility has been found in all species examined for this character and it is likely that the seed collected from the tree has resulted from self-pollination although probably from different flowers on the same tree. Crossing with adjacent *E. rubida* is unlikely because the flowering times of the two are well separated. In 1951 in this area the *E. rubida* flowered in January, and the supposed hybrid about the end of March. It is true that *E. maculosa* started to flower about the end of March also, but it seems that the distance to the nearest trees would at least reduce the amount of out-crossing, if not eliminate it, and favour a high proportion of self-pollination unless partial or complete self-sterility were the case. The kind of segregation disclosed by the progeny however is not as would be expected from a back-cross.

With regard to the possibility of out-crossing, it should be remembered that the distance as in this case, and the separation of the general flowering times, are probably not absolute bars to some cross-pollination, but the chance, if the individual is self-fertile, of other than a very small portion of the seed in the capsules arising from out-crossing is quite small.

It is true that complete confirmation can be obtained only after a progeny is obtained following controlled self-pollination, but in any case, apart from the theoretical possibility of the seed in the progeny test resulting from out-crossing with another as yet undiscovered hybrid individual in the same locality, it is likely the progeny obtained from the resistant tree is from self-pollinated capsules and fairly indicates the genetic constitution of the individual.

The position is somewhat similar with the susceptible individual amongst the *E. Macarthuri* trees. In 1951, it flowered in the latter half of March while the surrounding *E. Macarthuri* flowered in February. *E. rubida* is within 100 yards of the tree, but flowered still earlier in the year. *E. viminalis* and *E. maculosa* flowered at the same time, but are some 400–800 yards distant respectively. It is likely in this case also that the progeny is from seed resulting from self-pollination.

The mode of inheritance of resistance to insect attack should become clearer when the progenies are older. If in the progeny from the presumptive *E. rubida* × *E. maculosa* hybrid, susceptibility segregates to any degree independently of other characters, it should be possible to select various desired combinations with the resistance of *E. maculosa* which could be propagated vegetatively. In the presumptive hybrid it is interesting that the tree is as resistant as *E. maculosa* and therefore, instead of blending as is commonly the case with various morphological characters, the character